TECHNICAL INFORMATION SERIES

AUTHOR A.J.Welling A.J.Welling/JRN	SUBJECT CLASSIFICATION Transformers - Impulse Tests	NO. 55TP85 DATE 9-21-55
TITLE Detection of Flashovers or Arcs During the Low Voltage Winding Impulse Test on Distribution Transformers.		

STRICTLY PRIVATE

FOR USE OF G-E EMPLOYEES ONLY

GENERAL ELECTRIC

TRANSFORMER AND ALLIED PRODUCTS DIVISION

12 (11-48)

4

[redacted]

TA-809-T (8-52)

FOR USE OF G-E EMPLOYEES ONLY

GENERAL ELECTRIC

TECHNICAL INFORMATION SERIES

Title Page

AUTHOR	SUBJECT CLASSIFICATION	NO.
A.J.Welling A.J.Welling/JRN	Transformers - Impulse Tests	55TP85
		DATE 9-21-55

TITLE
Detection of Flashovers or Arcs During the Low Voltage Winding Impulse Test on Distribution Transformers.

ABSTRACT

The sensitivity of a circuit for detecting flashovers or arcs when the low voltage winding of distribution transformers is impulsed with negative 0.7 by 1.5 waves was investigated.

G.E. CLASS	REPRODUCIBLE COPY FILED TECHNICAL DOCUMENTS	NO. PAGES
1V	Pittsfield, Mass.	7
GOV. CLASS		

CONCLUSION

1. The lowest ratio between the amplitudes of no fault and fault signals was 2/1 and the highest was 14/1.
2. This new method will be employed in the Hickory automatic impulse test.

By cutting out this rectangle and folding on the center line, the above information can be fitted into a standard card file.

For list of contents-drawings, photos, etc. and for distribution see reverse side.

INFORMATION PREPARED FOR Distribution Transformer Engineering Section/J.E.Holcomb

TESTS MADE BY A.J.Welling

COUNTERSIGNED J.R.Nye J.R.Nye SECTION High Voltage Laboratory

BUILDING and ROOM No. 9-314 LOCATION Pittsfield

TA-809 (12-50)

CONTENTS OF REPORT

Ref. No. DP 304

NO PAGES TEXT	3
NO CHARTS	2
DRAWING NOS.	171HA996 171HA997
PHOTO NOS.	

DISTRIBUTION

COMPLETE COPIES

J.L.Cantwell, #27-381
J.H.Hagenguth/T.R.Walters, #9-202
J.E.Holcomb #27-381
Library, 8B-22
W.A.McMorris, #27-388
J.R.Nye, #9-314
E.N.Turner/N.M.Case, #28-315
A.J.Welling, Phila. Lab.
File (3), #9-314
RW Knowles, #7-107
SC Leonard, #7-205

TITLE SHEETS

M.Broverman #28-337
H.A.Frey, Locke Dept.,Balti
H.S.Hubbard, #42-506
E.K.Kane, #43-382
Library (6), #8-22
W.A.McMorris, #27-388
J.R.Meador, #16-326
W.Morrill, #7-260
E.L.Raab, #8-33
A.F.Rohlfs, #9-203
W.J.Rudge, #43-550
M.E.Scoville, Hudson Falls
G.G.Somerville #7-215
J.D.Stacy, Hudson Falls
T.R.Walters, #9-204
L.Wetherill, #42-322
F.L.Woods, #43-382
S.T.Maunder, Holyoke

T.I.S. 55TP85

DETECTION OF FLASHOVERS OR ARCS DURING THE LOW VOLTAGE WINDING IMPULSE TEST ON DISTRIBUTION TRANSFORMERS

Introduction

The method presently used to detect flashovers or internal bushing arcs which occur during the low voltage winding impulse test depends upon the time rate of change of the voltage tail of the applied wave. Since the tail of the normal applied wave is approximately one microsecond in duration, the change caused by a flashover is very slight.

In order to improve the fault detection ability, a new method of flashover detection was devised and tested using several transformers. The results were considered very good and this method will replace the old method in the automatic test at Hickory.

The impulse wave applied to the low voltage windings of distribution transformers is approximately a 0.7 x 1.5 microsecond wave. This wave is normally oscillatory and its second peak is of opposite polarity from the first. (See Fig. I). With the occurrence of a flashover or internal bushing arc to ground practically all of the second peak is eliminated.

This difference in the size of the second peak between a normal wave and the chopped wave resulting from a failure is the basis upon which the new detection circuit works.

Description of Test Circuit

The detection circuit is essentially an integrating circuit consisting of (8) IN75 germanium rectifiers and a 0.01 microfarad capacitor. For the test, this circuit was connected to a resistance divider in order to tap off a certain amount of the applied wave. (See Fig. II). The purpose of the germanium was to eliminate the first peak of the applied wave and to pass the second. The voltage developed across the 0.01 microfarad capacitor was impressed upon oscillograph plates for measurement. Since the two halves of the low voltage winding are oppositely wound, the germaniums connected to the X_1 lead through the resistance divider were reversed in order to eliminate the first peak of the voltage induced in that half of the low voltage winding.

Procedure

0.7 x 1.5 microsecond impulse waves at the 25 kv level were applied to X_3 with X_2 and H_2 grounded (see Fig. II). The voltage developed across C_1 was impressed on oscillograph plates and photographed both for a normal applied wave and again when the X_3 bushing flashed over. This procedure was repeated with the voltage across C_2 and with the X_1 bushing flashing over. Ten transformers were tested in this manner.

Discussion and Conclusions:

The use of two detection circuits, one for each half of the low voltage winding is necessary to insure 100% fault detection. A flashover on the X_1 bushing would not necessarily be detected with the circuit connected to X_3. The construction of some transformers is such that the coupling between the two halves of the low voltage winding is not perfect.

Placing the germaniums, C_1 and the 250-~ resistor in a small metal container improves the results by eliminating external pickup. Tapping off a greater signal from the resistance divider also improves the results.

The overall results are considered sufficient to replace the old detection circuit with this new method.

Results:

Detection circuit connected to X_3 through resistance divider

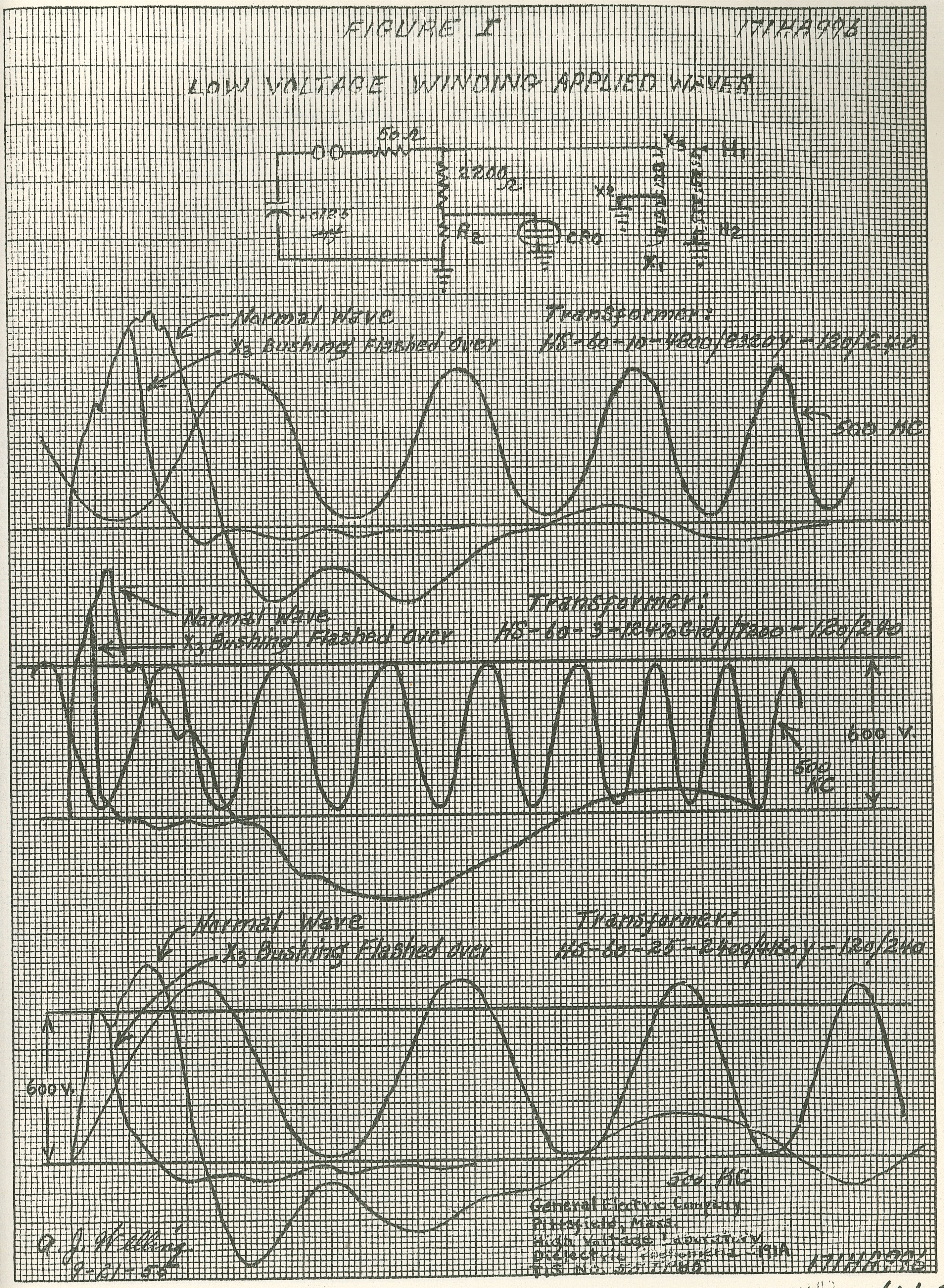
Transformer Tested	R2 ohms	Voltage measured across Scope Plates Volts-Peak: Normal Applied Wave	Voltage measured across Scope Plates Volts-Peak: When X_3 Flashed Over
3-7200-120/240	71.5	230	0
	100.0	300	30
	150.0	420	30
10-7200-120/240	71.5	169	47
37-1/2-4160-120/240	71.5	122	47
	100	165	60
	150	228	60
	200	---	68
25-2400-120/240	71.5	115	25
	100	160	40
	150	220	50
	200	---	64
5-17200-120/240	100	312	45
	150	450	58
10-480-120/240	71.5	116	38
	100	159	38
	200	255	59
3-4800-120/240	71.5	180	22
50-480-120/240	71.5	125	35
37-1/2-480-120/240	71.5	180	55
75-2400-120/240	71.5	88	44

Detection circuit connected to X_1 through resistance divider

Transformer Tested	R2 Ohms	Voltage Measured Across Scope Plates Volts-Peak: Normal Applied Wave	Voltage Measured Across Scope Plates Volts-Peak: When X_1 Flashed Over
3-7200-120/240	71.5	191	0
	100	260	50
	150	360	50
10-7200-120/240	71.5	130	53
10-4800-120/240	71.5	75	26
	100	113	28
37-1/2-4160-120/240	71.5	85	28
	100	165	48
	150	217	48
	200	248	66
25-2400-120/240	71.5	90	0
	100	160	50
	150	220	50
	200	260	50
5-17,200-120/240	100	350	60
	150	455	60

FIGURE I 171HA996

LOW VOLTAGE WINDING APPLIED WAVES



General Electric Company
Pittsfield, Mass.
High Voltage Laboratory
Dielectric [illegible] -191A
TIS No. 55 [illegible] 180

Q. J. Willing
9-21-55

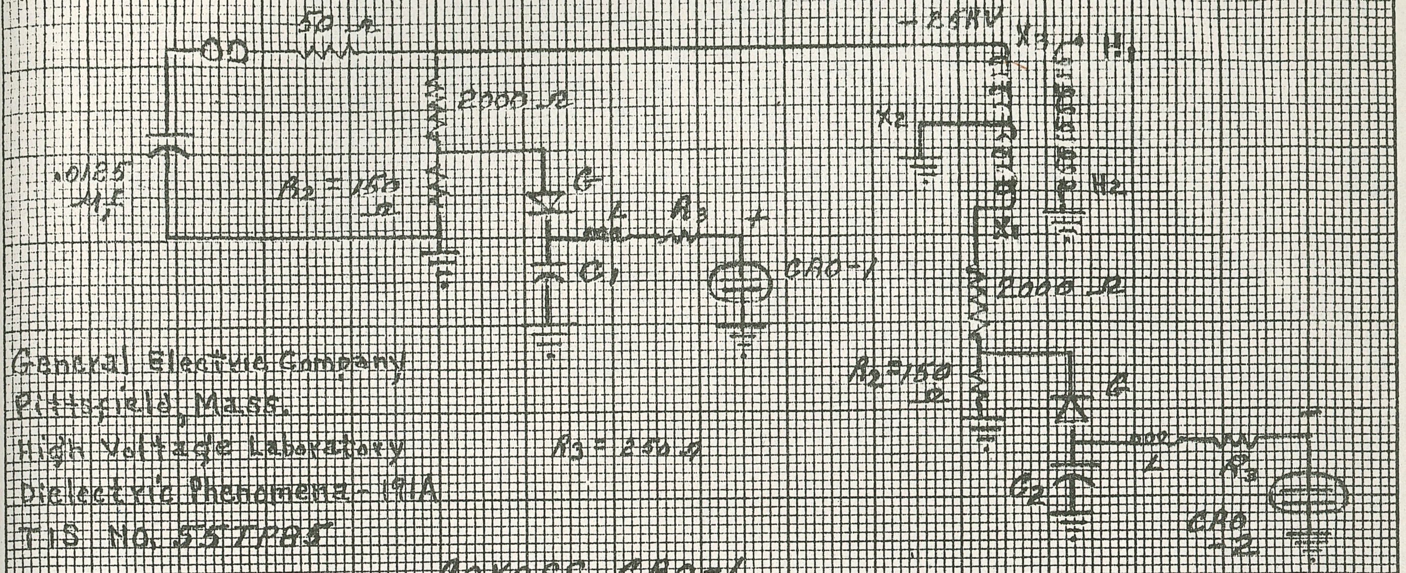
171HA996

12/6/55

FIGURE II

171HA997

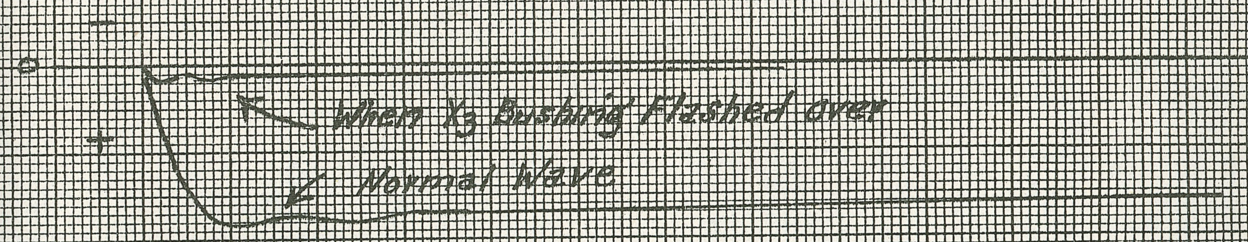
Fault and No Fault Voltages Seen Across Scope Plates



General Electric Company
Pittsfield, Mass.
High Voltage Laboratory
Dielectric Phenomena - 191A
TIS No. 55TP85

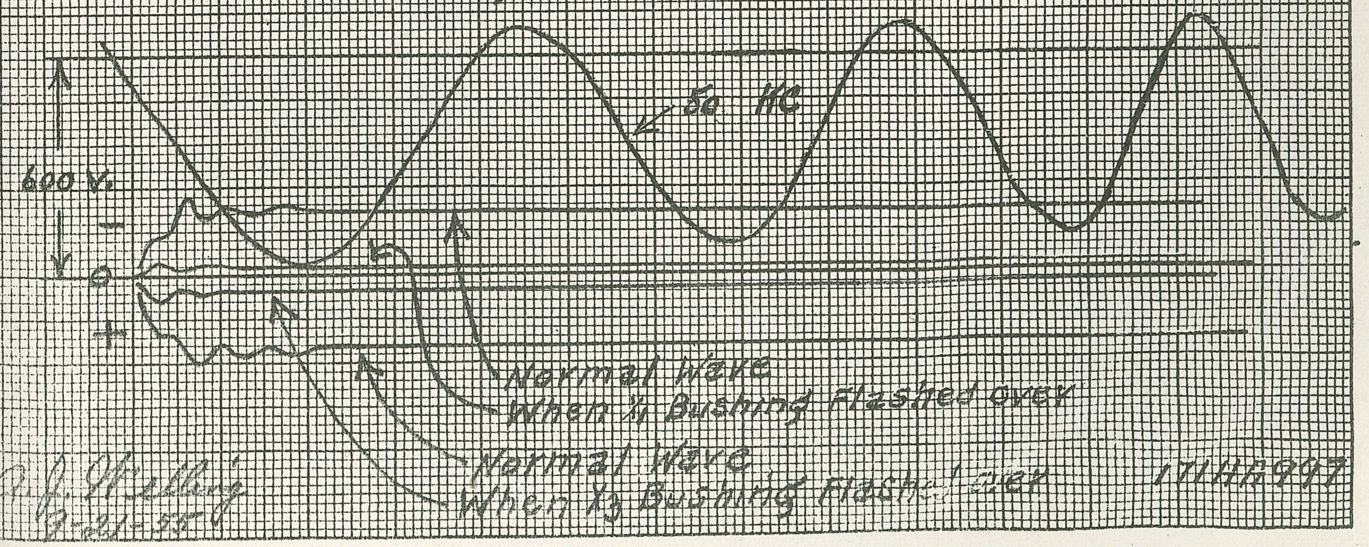
Across CRO-1

Transformer: HS-60-3-7200/12470Y-120/240



Across CRO-1 and CRO-2

Transformer: HS-60-25-2400/4160Y-120/240



A. J. Welling
9-21-55

171HA997

12/6/55